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Ethan A. Litman MD , Ying Yin PhD , Stuart J. Nelson MD , Emily Capbarat MD , Daniel Kerchner MS , Homa K. Ahmadzia MD, MPH

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Original Research

Adverse Perinatal Outcomes in a Large US Birth Cohort During the COVID-19 Pandemic

Adverse Perinatal Outcomes During COVID-19

Ethan A. Litman[1,*] elitman@gwu.edu , MD, Ying Yin[2], PhD, Stuart J. Nelson[2], MD, Emily Capbarat[1], MD, Daniel Kerchner[3],MS, Homa K. Ahmadzia[4], MD, MPH
[1]Department of Obstetrics and Gynecology, George Washington University, Washington, DC, USA
[2]Biomedical Informatics Center, George Washington University, Washington, DC, USA
[3]George Washington University Libraries, George Washington University, Washington, DC, USA
[4]Department of Obstetrics and Gynecology, Division of Maternal-Fetal Medicine, George Washington University, Washington, DC, USA
[*]Corresponding Author: Ethan A Litman, 2150 Pennsylvania Ave NW, Washington, DC 20037

Abstract

Objective: To investigate whether coronavirus disease 2019 (COVID-19) is associated with adverse perinatal outcomes in a large national dataset and to examine rates of adverse outcomes during the pandemic compared to pre-pandemic period.

Methods: This observational cohort study included 683,905 patients, between the ages of 12-50, hospitalized for childbirth and abortion between January 1, 2019 and May 31, 2021. During the pre-pandemic period, 271,444 women were hospitalized for childbirth. During the pandemic, 308,532 women were hospitalized for childbirth and 2,708 had COVID-19. Associations between COVID-19 and in-hospital adverse perinatal outcomes were examined using propensity score-adjusted logistic regression.

Results: Compared to women without COVID-19, women with COVID-19 were more likely to experience both early and late preterm birth (aOR 1.38 [95% CI 1.1-1.7], aOR 1.62 [95% CI 1.3-1.7], respectively), preeclampsia (aOR 1.2 [95% CI 1.0-1.4]), disseminated intravascular coagulopathy (DIC) (aOR 1.57 [95% CI 1.1-2.2]), pulmonary edema (aOR 2.7 [95% CI 1.1-6.3]), and need for mechanical ventilation (aOR 8.1 [95% CI 3.8-17.3]). There was no significant difference in the prevalence of stillbirth among women with (n= 16 / 2,708) and without (n= 174 / 39,562) COVID-19, p=0.257. There were no differences in adverse outcomes among women

who delivered during the pandemic versus pre-pandemic period. Combined in-hospital mortality was significantly higher for women with COVID-19 (147 [95% CI 3.0 -292] vs 2.5 [95% CI 0-7.5] deaths per 100,000 women). Women diagnosed with COVID-19 within 30 days prior to hospitalization were more likely to experience early preterm birth, placental abruption, and mechanical ventilation, compared to women diagnosed with COVID-19 > 30 days prior to hospitalization for childbirth (4.0% vs. 2.4% for early preterm birth, aOR 1.7 [95% CI 1.1-2.7]; 2.2% vs. 1.2% for placental abruption, aOR 1.86 [95% CI 1.0 - 3.4]); 0.9% vs. 0.1% for mechanical ventilation, aOR 13.7 [95% CI 1.8-107.2])).

Conclusion: Women with COVID-19 had a higher prevalence of adverse perinatal outcomes and increased in-hospital mortality, with highest risk occurring when diagnosis was within 30 days of hospitalization, raising the possibility of a high-risk period.

Key Words
COVID-19, Adverse perinatal outcomes, high-risk pregnancy

Introduction

Scientific consensus has yet to be achieved regarding the clinical impact of coronavirus disease 2019 (COVID-19) infection in pregnancy. A recent meta-analysis of a global population demonstrated worsened maternal and fetal outcomes during the COVID-19 pandemic, with large disparities between high and low resource countries.[1] While some studies[2, 3] support this meta-analysis, other studies [4-7] have demonstrated a mixed effect of the impact of COVID-19 on pregnancy. One of the largest US study showed a significant difference in mortality rates, ICU admission, and preterm birth among women with COVID-19.[3] However, most US studies were

smaller in size and were conducted during the first few months of the pandemic, prior to the largest increase in COVID-19 case numbers and fatalities in the US, during fall and winter 2020.[8] We utilized a large cohort to study the effect of COVID-19 on perinatal outcomes occurring during fall and winter 2020. We investigated the relationship between the timing of COVID-19 diagnosis and childbirth to adverse perinatal outcomes. Additionally, we examined the change in adverse perinatal outcomes by comparing the 14-month pandemic period to the 13 months prior to the pandemic.

Methods

Women who gave birth between January 1, 2019 and May 31, 2021 were identified by *International Statistical Classification of Disease and Related Health Problems, Tenth Revision (ICD-10) codes* from Cerner Real-World Database™, which is extracted from the electronic health records of hospitals with which Cerner™ has a data-use agreement. Childbirth during the pandemic period was defined as occurring between March 1, 2020 to May 31, 2021, while childbirth prior to the pandemic (pre-pandemic period), was defined as occurring between January 1, 2019 to February 28, 2020. Race and ethnicity were self-reported, body mass index was calculated using measured height and weight, COVID-19 status was determined using the COVID-19 polymerase-chain (PCR) test result, and comorbidities and in-hospital outcomes were identified using *ICD-10* and billing codes (Appendix 1). The COVID-19 positive cohort included only women with a positive PCR result during pregnancy. The COVID-19 negative cohort included women with a negative PCR result on admission who never had positive PCR result during pregnancy. The difference between the date of hospitalization and the PCR test result was

used to calculate the days since COVID-19 infection. Early and late preterm birth were defined as a live birth between 24-33 and 34-36 completed weeks gestation, respectively. Stillbirth was defined as fetal death beyond 19 completed weeks gestation.

The percent of women with COVID-19 by first, second, and third trimester were 12.7%, 26.1%, and 61.2%, respectively. 877 pregnant women with a positive COVID PCR result were excluded (592 women did not have a documented gestational age, 285 had a positive result prior to pregnancy). Most COVID-19 diagnoses occurred near hospitalization, with 49.5% within 0-30 days, 10.2% within 31-60 days, 17.6% within 61-120 days, and 22.6% greater than 120 days prior to hospitalization.

The Institutional Review Board approved the study protocol and waived the requirement for patient informed consent. Multivariable logistic regression was used to derive a propensity score of COVID-19 infection based on baseline conditions to estimate the probability of developing COVID-19 as a function of 17 baseline covariates, including age, ethnicity, race, single digit zip code, trimester, asthma, autoimmune disease, chronic hypertension, chronic kidney disease, gestational hypertension, gestational diabetes, major mental illness, morbid obesity, obesity, pregestational diabetes, pulmonary disease, and tobacco use. Associations between COVID-19 and in-hospital outcomes were examined using propensity score-adjusted regression. Subgroup analyses were performed to detect differences in adverse perinatal outcomes by racial category. Analyses were conducted using SciKit-Learn[9] and Statsmodels[10] Python Library, with a two-tailed p-value less than .05 considered significant. Categorical variables such as demographics, pre-existing conditions, and outcomes were compared using the Chi-squared test. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.[11]

Results

During the pandemic period, 308, 532 women were hospitalized for childbirth; of those tested, 39,562 had a negative COVID-19 PCR result, 2,708 (6.4%) had COVID-19, and of those who tested positive, 1342 (49.5%) were diagnosed with COVID-19 within 30 days prior to hospitalization for childbirth. Compared to women without COVID-19, women with COVID-19 were younger, more likely to identify as Hispanic, and more likely to have comorbid asthma, pulmonary disease, hypertension, gestational hypertension, diabetes, gestational diabetes, obesity, or morbid obesity (Table 1).

Women with COVID-19 were more likely to experience preterm birth (early preterm birth 3.2% vs. 2.2%, aOR 1.38 [95% CI 1.1-1.7] late preterm birth 9.0% vs. 5.8%; 1.62 [95% CI 1.3-1.7]), preeclampsia (8.0% vs. 6.1%, aOR 1.2 [95% CI 1.0-1.4]), placental abruption (1.7% vs. 0.9%, aOR 1.86 [95% CI 1.4-2.5]), DIC (1.3% vs. 0.8%, aOR 1.57 [95% CI 1.1-2.2], pulmonary edema (0.3% vs. 0.1%, aOR 2.67 [95% CI 1.-6.3]) , and require mechanical ventilation (0.5% vs. 0.05%, aOR 8.12 [95% CI 3.8-17.3]) (Table 2).

Women diagnosed with COVID-19 within 30 days of hospitalization for childbirth had the highest prevalence of adverse perinatal outcomes (Appendix 2). Among women diagnosed with COVID-19 in pregnancy, women diagnosed with COVID-19 within 30 days of hospitalization for childbirth had the highest risk of early preterm birth (4.0% vs. 2.4%, aOR 1.7 [95% CI 1.1-2.6]), placental abruption (2.2% vs. 1.2%, aOR 1.8 [95% CI 1.0-3.4]) and the need for mechanical ventilation (0.9% vs. 0.1%, aOR 13.7 [95% CI 1.8 - 107.1]) (Table 2).

In-hospital mortality was significantly higher for women with COVID-19 versus women without COVID-19 (147 [95% CI 3.0 - 292] vs 2.5 [95% CI 0 – 7.5] deaths per 100,000 women, $p < 0.0001$). The majority of in-hospital deaths among women with COVID-19 occurred in women who were diagnosed with COVID-19 within 30 days of hospitalization (Appendix 2).

There was no significant difference in the prevalence of stillbirth between women with and without COVID-19 (0.6% vs. 0.5%; aOR 1.46 [95% CI, 0.8-2.4], Table 2). However, the prevalence of stillbirths occurring in women diagnosed with COVID-19 within the previous 30 days was significantly greater compared to women diagnosed with COVID-19 31-60 days, 60-120 days, or greater than 120 days prior to hospitalization (11/16 (68.8%), 0/16 (0 %), 3/16 (18.7%), 2/16(12.5%) respectively, $p < 0.001$) (Appendix 2). A similar pattern was observed for the prevalence of placental abruption, DIC, premature prelabor rupture of membranes (PPROM), and need for mechanical ventilation (Appendix 2).

During the pre-pandemic period, 271,444 women were hospitalized for childbirth. Compared to the pre-pandemic period, women hospitalized for childbirth during the pandemic period were more likely to have comorbid gestational diabetes, gestational hypertension, hypertension, obesity, morbid obesity, and major mental illness (Appendix 3). Compared to the pre-pandemic period, there was no significant difference in the number of stillbirths, the prevalence of early or late preterm birth, or in-hospital mortality among women who delivered during the pandemic period (Table 3).

Discussion

Principle Findings

In a large cohort of US women hospitalized for childbirth, we found that in-hospital mortality, preterm birth, preeclampsia, placental abruption, and DIC were statistically significantly higher among COVID-19 positive women compared to COVID-19 negative women. Women with COVID-19 who were diagnosed within 30 days of hospitalization had the highest prevalence of in-hospital mortality, stillbirth, placental abruption, PPROM, DIC, early and late preterm birth, and need for mechanical ventilation.

Results

To date, this is the third largest US cohort of pregnancies during the COVID-19 pandemic and the second largest US cohort of COVID-19 positive patients. The utilization of a large childbirth cohort enabled us to detect statistically significant differences in mortality and adverse outcomes, even while absolute rates of death and adverse perinatal outcomes were low overall.[12-14] We were also able to demonstrate a temporal effect of COVID-19 on adverse perinatal outcomes, suggesting a high-risk period.

Our findings of increased risk of preterm birth, preterm labor, and development of pre-eclampsia among women found to have COVID-19 who were hospitalized for childbirth have not been consistently reported in previous US studies[1,5], which may be due to a longer study period, larger sample size in the current study, and the development of novel variants during the study period. Interestingly, in the largest reported US cohort to date, Chinn et al.[3] demonstrated a greater degree of risk of preterm birth among women diagnosed with COVID-19 and hospitalized for childbirth, than the current study. However, unlike Chinn et al., our study accounted for differences in pre-existing comorbid conditions in the cohort, which may account for the variation.

This study did not demonstrate a difference between the prevalence of adverse perinatal outcomes in the year preceding the pandemic and the first 16 months of the pandemic, which was surprising, given the disruptive nature of the COVID-19 pandemic. Some studies have reported decreased premature birth rates during the pandemic, however smaller sample sizes and shorter study period may have biased results.[15,16] Compared to the pre-pandemic period, women hospitalized for childbirth during the pandemic period were more likely to have comorbid asthma, gestational diabetes, gestational hypertension, hypertension, obesity, and major mental illness, which may be related to non-infectious, environmental disruptive effects of the pandemic. However, any relationship of these findings to the absence of differences in perinatal adverse outcomes between pre-pandemic and pandemic periods is speculative and not adequately addressed by our study design.

Strengths and Limitations

Our study has other limitations that may affect the veracity of our findings. This was an observational study with data abstracted from medical records, which are subject to potential misclassification or information bias. Due to the development of readily accessible COVID-19 testing and routine screening of all hospitalized patients, women who appeared clinically ill may have experienced selection bias towards more frequent testing. Furthermore, this study is unable to provide information about the severity of COVID-19 disease among patients who tested positive. This study is unable to differentiate iatrogenic preterm birth from spontaneous preterm birth, which may be an important driver of preterm birth. Lastly, low case rates and residual confounding may further impact the clinical significance of the results.

Clinical Implications

Despite these limitations, our study, which focused on a longer peak period of COVID-19 infection, demonstrates that women hospitalized for childbirth with a history of COVID-19 have a higher prevalence of adverse perinatal outcomes and increased in-hospital mortality, consistent with previously reported global results. Future investigation is warranted and should include the delineation of a high-risk period for adverse perinatal outcomes after COVID-19 diagnosis, as enhanced antenatal surveillance may be warranted for women recently diagnosed with COVID-19.

Condensation:

Women with COVID-19 had a higher incidence of adverse perinatal outcomes, with the highest risk occurring in women diagnosed within 30 days of hospitalization.

AJOG at a Glance:

A. To investigate whether coronavirus disease 2019 (COVID-19) is associated with adverse perinatal outcomes using a nationally representative dataset of 683,905 pregnancies, including 2,708 COVID positive patients.

B. Compared to women without COVID-19, women with COVID-19 were more likely to experience both early and late preterm birth, preeclampsia, and venous thromboembolism. Combined in-hospital mortality was significantly higher for women with COVID-19. Women diagnosed with COVID-19 within 30 days prior to hospitalization were more likely to experience adverse pregnancy outcomes compared to women diagnosed with COVID-19 > 30 days prior to hospitalization for childbirth.

C. Women with COVID-19 had a higher prevalence of adverse perinatal outcomes and increased in-hospital mortality, with highest risk occurring when diagnosis was within of 30 days of hospitalization, raising the possibility of a high-risk period.

Additional Article Information: Cerner Real World Data™ encounters may include pharmacy, clinical and microbiology laboratory, admission, and billing information from affiliated patient care locations. All admissions, medication orders and dispensing, laboratory orders and specimens are date and time stamped, providing a temporal relationship between treatment patters and clinical information. Cerner Corporation has established Health Insurance Portability and Accountability Act-compliant operating policies to establish de-identification for Cerner Real-World.

Funding Source
The work was not funded

Declaration of Competing Interest
EAL, YY, SN, EC, DK, HKA have no conflict of interests to disclose

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Table 1: Baseline Characteristics of Hospitalized Pregnant Woman During the COVID-19 Pandemic by COVID-19 Status

Characteristics	No. (%) COVID-19 Within 30 days (n= 1,342)	COVID-19 Positive (n= 2,708)	Without COVID-19 (n= 39,562)	P value*
Trimester				
First	16 (1.2)	22 (0.8)	478 (1.2)	
Second	23 (1.7)	29 (1.1)	412 (1.0)	0.824
Third	1,303 (97.1)	2,657 (98.1)	38, 672 (97.8)	
BMI†	32.0 [27.0-37.0]	32.0 [28.0-37.0]	31.0 [27.0-36.0]	
Age, mean (SD), y	28.8 (5.8)	28.9 (5.8)	29.7 (5.7)	
Age, category, y				
≤24	322 (24.0)	656 (24.2)	7,923 (20.0)	
25-34	769 (57.3)	1550 (57.2)	23,311(57.0)	0.015
35-44	248 (18.5)	498 (18.4)	8,207 (20.7)	
≥45	3 (0.2)	4 (0.2)	121 (0.3)	
Race/ethnicity				
White, non-Hispanic	521 (38.9)	1, 052 (38.9)	20,696 (52.3)	
Black, non-Hispanic	119 (8.9)	293 (10.8)	3,595 (9.1)	0.095
Hispanic	580 (43.2)	1,142 (42.2)	12,047 (30.5)	
Asian	26 (1.9)	45 (1.7)	852 (2.1)	
Other/Unknown	96 (7.1)	176 (6.5)	2,372 (6.0)	
Comorbidities				
Asthma	148 (11.0)	414 (15.3)	2,193 (5.5)	< 0.001
Autoimmune disease	4 (0.3)	10 (0.4)	128 (0.3)	0.687
Chronic kidney disease	8 (0.6)	21 (0.8)	219 (0.6)	0.138
Diabetes	29 (2.2)	83 (3.1)	756 (1.9)	< 0.001
Gestational diabetes	100 (7.5)	214 (7.9)	2,769 (7.0)	0.087
Gestational hypertension	44 (3.2)	114 (4.2)	1,338 (3.4)	0.025
Hypertension	50 (3.7)	155 (5.7)	1,896 (4.8)	0.033
Major mental illness	86 (6.4)	245 (9.0)	3,521 (8.9)	0.804
Morbid obesity	45 (3.4)	139 (5.1)	1,349 (3.4)	< 0.001
Obesity	263 (19.6)	630 (23.3)	6,679 (16.9)	< 0.001
Pulmonary disease	70 (5.2)	182 (6.7)	1,846 (4.7)	< 0.001
Smoking	35 (2.6)	101 (3.7)	1,1675 (4.2)	0.216

Abbreviation: BMI, Body mass index.

* Reflects comparisons between patients with COVID-19 and without COVID-19 were analyzed.
† BMI calculated as weight in kilograms divided by height in meters, reported as median [IQR].

Table 2: Comparison in-hospital outcomes of pregnant woman during the COVID-19 Pandemic based on COVID-19 Status

	No. (%)			Without COVID-19 Vs. COVID-19 Positive†		COVID-19 Within 30 days Vs. COVID-19 > 31 days†	
Outcome	COVID-19 Within 30 days* (n= 1,342)	COVID-19 Positive (n= 2,708)	Without COVID-19 (n= 39,562)	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)
Early preterm birth	52 (4.0)	84 (3.2)	844 (2.2)	**1.47 (1.2-1.8)**	**1.38 (1.1-1.7)**	**1.7 (1.1-2.6)**	**1.70 (1.1-2.6)**
Late preterm birth	113 (8.6)	239 (9.0)	2,230 (5.8)	**1.62 (1.4-1.9)**	**1.50 (1.3-1.73)**	0.9 (0.7-1.2)	1.0 (0.8-1.3)
Term birth	1,151 (87.7)	2,349 (88.3)	35, 646 (92.3)	**0.72 (0.6-0.8)**	**0.73 (0.7-0.8)**	0.9 (0.7-1.1)	0.9 (0.7-1.1)
Cesarean delivery	419 (31.9)	826 (31.1)	12,916 (33.4)	**0.91 (0.8-1.0)**	**0.91 (0.8-1.0)**	1.11 (0.9-1.2)	1.14 (1.0-1.3)
Birth Weight‡, Median, g	3396 [2698-3769]	3418 [3093-3780]	3400 [2950-3785]				
PPROM	33 (2.5)	72 (2.7)	814 (2.1)	1.3 (1.0-1.7)	1.2 (1.0-1.6)	0.86 (0.5-1.4)	0.83 (0.5-1.3)
	11	16	17	1.35	1.5 (0.9-	1.25 (0.8-	1.66

Stillbirth	(0.8)	(0.6)	4 (0.5)	(0.8-2.3)	2.5)	6.5)	(0.6-4.9)
Blood product transfusion	15 (1.1)	23 (0.9)	23 7 (0.6)	1.42 (0.9-2.2)	1.41 (0.9-2.2)	1.92 (0.8-4.5)	1.76 (0.7-4.2)
Sepsis	19 (1.4)	22 (0.8)	71 (0.2)	**4.56 (2.8-7.4)**	**3.73 (2.3-6.2)**	**6.52 (1.9-22.1)**	**6.93 (2.0-23.8)**
Shock	91 (6.8)	161 (6.0)	2,313 (5.9)	1.02 (0.9-1.2)	0.95 (0.8-1.3)	1.35 (0.98-1.9)	**1.48 (1.1-2.1)**
Preeclampsia	103 (7.7)	215 (7.9)	2,407 (6.1)	**1.32 (1.2-1.5)**	**1.20 (1.0-1.4)**	0.93 (0.7-1.23)	1.1 (0.8-1.5)
Eclampsia	2 (0.2)	7 (0.3)	21 (0.1)	**4.88 (2.1-11.5)**	**4.71 (2.0-11.35)**	0.41 (0.1-2.1)	0.38 (0.1-2.0)
DIC	21 (1.6)	35 (1.3)	345 (0.9)	**1.49 (1.1-2.1)**	**1.57 (1.1-2.2)**	**1.54 (0.8-3.0)**	**1.59 (0.8-3.2)**
HELLP	4 (0.3)	6 (0.2)	76 (0.2)	1.2 (0.5-2.7)	1.16 (0.5-2.7)	**0.4 (0.4-11.2)**	**2.1 (0.4-12.0)**
Myocardial infarction[§]	2 (0.2)	4 (0.2)	8 (0.0)	**7.31 (2.2-24.3)**	**7.48 (2.2-25.5)**	1.0 (0.1-7.2)	1.23 (0.2-9.2)
VTE	3 (0.2)	5 (0.2)	55 (0.1)	1.3 (0.5-3.3)	1.24 (0.5-3.2)	1.53 (0.3-9.2)	1.87 (0.3-11.7)
Mechanical ventilation	12 (0.8)	13 (0.5)	18 (0.1)	**10.6 (5.2-21.7)**	**8.12 (3.8-17.3)**	**12.32 (1.6-94.9)**	**13.7 (1.8-107.2)**
Length	3	3	3				

of stay[||]	[3-4]	[3-4]	[3-4]
Discharge disposition			
Home	1,299 (96.8)	2,610 (96.4)	38,117 (96.4)
Postacute care	12 (0.9)	37 (1.4)	324 (0.8)
Death	3 (0.2)	4 (0.1)	1 (0.0)
Rehab	8 (0.6)	10 (0.4)	209 (0.5)
Hospice	1 (0.1)	1 (0.0)	49 (0.1)
Other	19 (1.4)	46 (1.7)	862 (2.2)

Abbreviations: PPROM, preterm prelabor rupture of membranes; DIC, disseminated intravascular coagulopathy; HELLP, hemolysis, elevated liver enzymes, low platelets; ARDS, acute respiratory distress syndrome; VTE, venous thromboembolism; OR, odds ratio.

* Trimester-specific information was missing for 10.4% of COVID-19 positive patients.

† Adjusted for propensity score, which estimates the probability of developing COVID-19 as a function of 17 baseline covariates, including age, race, ethnicity, single digit zip code, trimester, chronic kidney disease, asthma, pulmonary disease, autoimmune disease, chronic hypertension, gestational, pregestational diabetes, gestational diabetes, major mental illness, morbid obesity, obesity, and tobacco use. The propensity score was defined as the logistic regression of the predicted probability of COVID-19 status. Statically significant outcomes, p< 0.05, in **boldface**

‡ Birth weight in grams, reported as median, [IQR].

§ Myocardial infarction was defined as the composite of myocardial infarction and cardiac arrest.

|| Length of stay in days, reported as median, [IQR].

Table 3: Comparison of In-Hospital Outcomes for Women Hospitalized for Childbirth Before and During The COVID-19 Pandemic

	No. (%)

Outcome	Pre-Pandemic* (n = 271,444)	Pandemic* (n= 308532)	P value
Early Preterm	7,848 (2.9)	9, 059 (2.9)	0.317
Late Preterm	18, 812 (6.9)	21,573 (7.0)	0.373
Term	221,135 (81.5)	252,190 (81.7)	0.252
Cesarean delivery	70,008 (25.8)	81,556 (26.4)	0.001
Birth Weight†	3,332 (2885-3760)	3,327 (2888-3740)	
PPROM	8,115 (2.5)	8,999 (2.5)	0.183
Stillbirth	1,697 (0.6)	2,018(0.7)	0.170
Blood product transfusion	3,044 (0.9)	3,665 (1.0)	0.012
Sepsis	561 (0.2)	598 (0.1)	0.308
Shock	19, 416 (6.1)	22,069 (6.1)	0.663
Preeclampsia	19,131 (6.0)	22,895 (6.3)	<0.001
Eclampsia	241 (0.1)	330 (0.1)	0.024
DIC	1,933 (0.6)	2,289 (0.6)	0.143
HELLP	755 (0.2)	840 (0.2)	0.733
Myocardial infarction‡	58 (0.0)	96 (0.0)	0.021
VTE	378 (0.1)	465 (0.1)	0.229
Mechanical ventilation	80 (0.0)	133 (0.0)	0.006
Length of stay§	3 [2-4]	3 [2-4]	
Discharge disposition			
Home	246,659 (90.6)	281,286 (91.2)	0.231
Post-acute care	9,259 (3.4)	9,811 (3.1)	
Death	27 (0.0)	39 (0.0)	
Hospice	39 (0.0)	132 (0.0)	
Rehab	815 (0.3)	916 (0.3)	
Other/Unknown	14, 645 (5.3)	16,348 (5.2)	

Abbreviations: PPROM, preterm prelabor rupture of membranes; DIC, disseminated intravascular coagulopathy; HELLP, hemolysis, elevated liver enzymes, low platelets; VTE, venous thromboembolism.

* The pre-pandemic period includes hospitalizations between 01/01/2019-02/28/2020; The pandemic period includes hospitalizations between 03/01/2020- 05/31/2021.

† Birth weight in grams, reported as median, [IQR].

‡ Myocardial infarction was defined as the composite of myocardial infarction and cardiac arrest.

§ Length of stay in days, reported as median, [IQR].